

THE FAUNA AND FLORA OF THE EL SEGUNDO SAND DUNES

11. THE DUNE CASE-BEARER BEETLES OF THE GENUS *EXEMA*, WITH REVIEW OF THE GENUS

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One of the most interesting groups of beetles to be found in the dune area is the case-bearers of the Chrysomeloidea, Chlamydidae, genus *Exema* Lacordaire (1848). They look more like little pellets of worm droppings than a beetle, and when disturbed can so fold in all appendages that only a sharp eye would detect them as living creatures.

More perfect fitting and grooving can hardly be found anywhere. The anvil-shaped scutellum locking the elytra; the dove-tailing teeth of the elytra; the cupped basisternite of the prosternum acting as a receptacle for the mouth parts; the deeply incised eyes; the perfect grooving of the head, and sides of the basisternite for the antennae; the double groove for the two front pairs of legs, and similar groove for the hind legs; the wavy margin of elytra; the rough tubercles and yellow spots; make the whole insect, when sulling, look like an oval pellet of a dropping of a worm.

The species are so roughly carved that they are difficult to describe and differentiate, although the characters are good.

We have a double reason for this article. Not only has *Exema* been taken feeding on three species of dune plants; but Mr. George Elwood Jenks has bred a new species and obtained all stages on a Los Angeles County plant, which is sparingly found on the dune, although his work was done elsewhere in the county. He has taken some remarkable photographs, which will shortly appear in Nature Magazine, but has asked the writer to make the technical descriptions.

The only life history in this group, which is at all well described is that of *Chlamys plicata* given in a footnote to his admirable description of the Dominican case-bearer, *Coscinoptera dominicana* (Fabr.) by Riley in his 6th Missouri Report (pp. 127-131).

Eight specific names have been given to North American members of this genus, and some of the descriptions are so brief as to be almost valueless. The writer was confronted with such contradictions and such meager details, that it became necessary to draw up descriptions of all the material at hand; and where there was any doubt as to specific identity, to give names which would absolutely qualify the material studied, with the expecta-

tion that studies of the types of the species of Olivier, Motschulsky, Mannerheim, and Lacordaire may necessitate future sinking of one or two of the names.

The descriptions are in accord with Snodgrass' morphological terminology; for only by arriving at some coördination of terms in descriptive work can we make proper judgment on phylogenetic relationships.

It is quite evident that biological and comparative morphological studies will reveal *Exema* to be a considerable genus.

Rather than draw up absolutely complete descriptions of each species, two species have been more completely described, and the others only for the characters which vary. Thus the description of *Exema chiricahuana* is most complete as to the general formation of the body, and that of *E. jenksi* goes into such details as were only possible after dissection, to describe.

KEY TO THE NORTH AMERICAN SPECIES OF *EXEMA*
DISCUSSED IN THIS ARTICLE

1. Prothorax carinate, tuberculate, and strigosely sculptured..... 2
Prothorax carinate, tuberculate and punctate 3
2. Face of male and frontal slope of prothorax dull clay yellow; face of female with yellow spots; front and middle legs in great part yellow. Florida 1. *neglecta* Blatchley
Face of male with two longitudinal yellow bars next to eyes, sometimes transversely connected with a yellow central spot, which merges with a triangular frontal spot; face of female has the bars reduced to two spots, the central spot reduced, and front with only two little spots in anterior corners; all tibiae with subapical and subbasal yellow rings; ocular emargination depressed below level of eyes. Canada (pl. II, fig. 2) 2. *dispar canadensis* n. ssp.
3. Prothorax with six longitudinal costae from base to apex 4
Prothorax with two to four longitudinal carinae, or the outer pair with short branches in some cases 5
4. Intervals between thoracic costae smooth. Mexico, Colombia, Brazil 3. *punctatipes* Lacordaire
Intervals between thoracic costae irregularly rugose and punctate. British Honduras, Guatemala 4. *complicata* Jacoby
5. Color dark cupreo-aeoneous; antennae, labrum and tarsi beneath pale; thorax and elytra densely punctate, and acutely tuberculate; prosternum concave. Carolina, Florida, Louisiana 5. *gibber* Fabricius (*nodulosa* Blatchley)
Color black, without metallic lustre, more or less spotted with yellow; thorax and elytra with obtuse tubercles 6
6. Prothorax medianly bicarinate, with two rows of punctures between carinae 7
Prothorax medianly bicarinate, with the carinae not subparallel, and with more than two rows of punctures, at least in front; face of male completely yellow 9

7. Anterior margin of elytra with parallel strigose lines ascending the tubercles in scutellar angles, and at middle of base; yellow spots confined to face and frontal elevation of thorax 8
- Anterior margin of elytra without strigose lines on tubercles; punctuation of face irregular; thorax and elytra with many yellow spots; eyes slightly raised above surrounding areas. California (pis. I-II, fig. 5) 6. *jenksi* n. sp.
8. Punctuation of face irregular, with smooth spots; ocular emargination depressed below level of eyes. Pennsylvania ...
..... 7. *pennsylvanica* n. sp.
- Punctuation of face more regular, without smooth spots. Eyes convex, forming with vertex a marginal depression, emargination depressed. California 8. *inyoensis* n. sp.
9. Male with thorax and elytra predominantly spotted with yellow ..10
Male with posterior portion of prothorax and elytra black11
10. Male pygidium with yellow spot on each side. California....
..... 9. *deserti* n. sp.
- Male pygidium predominantly yellow. Arizona (pl. II, fig. 1)
..... 10. *globensis* n. sp.
11. Male suprascrobal area dark; prothorax with two median rows of punctures from base to beginning of carinae; antecostal suture distinctly marked by deep round punctures; eyes slightly depressed below surrounding areas. Arizona (pl. II, fig. 3) 11. *chiricahuana* n. sp.
- Male suprascrobal area yellow; prothorax with indiscriminate punctuation from base to beginning of carinae; antecostal suture more impressed and with transverse punctures; eyes markedly depressed. California 12. *parvisari* n. sp.

SPECIES NOT DEFINITELY LOCATED

EXEMA CONSPERSA (MANNERHEIM), 1843

Chlamys conspersa Mannerheim, 1843. Bull. Mosc. 16 (1):311.

The original description follows:

“294. CHLAMYS CONSPERSA: Nigro-fusca, foveolatopunctata, thoracis medio pulvinato. elytris tuberculis elevatis scabris, sutura, crenata, fronte, thoracisque apice maculis majoribus notatis, thoracis disco, elytris et pedibus guttis minutis luteis conspersis. Longit. 1 lin. Latit. 2/3 lin. Habitat in California. D. Tschernikh.”

This description is too brief to assign it definitely to one of the California species, for it could be applied to *E. jenksi*, and *E. deserti* of California, and *E. globensis* of Arizona.

I consider it absolutely erroneous to try to fit it to any eastern species as has been done.

EXEMA RUGULOSA (MOTSCHULSKY), 1845

Chlamys rugulosa Motschulsky, 1845. Bull. Mem. Act. St. Pet., 18(1):109.

The original description follows:

"320. *Chlamys rugulosa* m. Elle est de la taille du *Pachybrachis histrio*, mais plus convexe et fortement raboteuse sur les élytres. Elle est noire avec quelques petites taches jaunes sur la tête et les pattes. De Californie."

With such a brief description it is impossible to assign this name to one of the California species, although, as far as color goes, it can apply to *E. inyoensis*, or *E. parvisaxi*, both of California, or to *E. chiricahuana* of Arizona.

I see no reason why we should assume that it is a synonym of *conspersa*, and as I have found no eastern species agreeing with any western species, I think we should try only to place this species as Californian, leaving it until its type can be examined, as a species inquirendum.

DESCRIPTIONS OF SPECIES CONSIDERED

1. EXEMA NEGLECTA BLATCHLEY, 1920

Exema neglecta Blatchley, 1920. Can. Ent. 52(3):69.

It is unnecessary to repeat this description. It may be a form of *E. dispar*.

The species is recorded from Florida on huckleberry and other low shrubs.

2. EXEMA DISPAR (DEJEAN MS.) LACORDAIRE, 1848

Chlamys dispar Dejean, 1836. Cat. ed. 3:440. Manuscript name.
Chlamys parvula Dejean, 1836. Cat. ed. 3:440. Manuscript name.
Exema dispar Lacordaire, 1848. Monographie des Coléoptères
... Phytophages. Mem. Soc. Roy. des Sciences de Liège,
5:850-852.

Inasmuch as our American literature has badly mixed up the eastern species, it is best not to try to assign the brief notes to specific species.

This is the species with strigose or rugulose lines on thorax and elytra.

Lacordaire's original description follows:

"6. *E. dispar*. Quadrato-oblonga, atra, labro, palpis, antennis, tarsisque fulvis; prothorace rugoso-punctulato, utrinque calloso, gibboso, gibbere obtuse conico, dorso obsolete canaliculato, granulis lineolisque elevatis obsito; elytris sat dense punctatis, scabriusculis, lineis elevatis obsolete, singuloque, tuberculis circiter novem, instructo.—Long. 3/4, 1 1/4. Lat. 2/5, 3/4 lin.

"Mas.: capite, prothoracis parte antica pedibusque fulvis, his nigrovariis.

"Var. A. Capite, prothorace pedibusque fulvo-nigroque variegatis.

"Var. B. Tota cinnamomeo-nigroque varia.

"Chlamys parvula, Dej. Cat. ed. 3, p. 440.

"Foem.: Pedibus fulvis nigro-maculatis, capite nigro interdum fulvovario; abdomine apice vage foveolato."

This description is followed by a fuller French description and statement that a type has been selected. The origin of the material is the United States, with distribution extended to Yucatan.

Inasmuch as Lacordaire included under the species a number of variants, the writer has decided to describe one lot of material at hand from Montreal as a subspecies, in order to clearly define this material, until a comparison can be made with Lacordaire's types.

2a. EXEMA DISPAR CANADENSIS new subspecies.

Described from 4 ♂, 3 ♀ from Montreal, in the collection of the Southern California Academy of Sciences, in the Los Angeles County Museum.

MALE: Length 2.1-2.3 mm.; breadth 1.6 mm., or 31 to 43% longer than broad.

Black, with exception of yellow markings on face and legs; face with two longitudinal yellow bars next to eyes, sometimes transversely connected with a central yellow spot, which more or less merges with a triangular frontal spot; labrum light brown with yellow margin, of different texture from the rest of the face; antennal scape yellow; funicle and club brown; all tibiae with subapical and subbasal yellow rings.

Face minutely granulate, irregularly punctate, much more sparsely so on yellow than on black areas. Black portion of vertex between eyes depressed, and with punctures in depressed striae; yellow bars on vertex very sparsely punctate. These bars are terminated at a line connecting the posterior margins of the ocular emarginations, and immediately in front of them are the slightly tumid, finely rugulose, impunctate suprascrobal areas over the antennal condyles. The yellow bars and these antennal attachments completely close the ocular emarginations from the balance of the face; this emargination is about as broad as deep, visibly depressed below margin of eyes, and deeply, closely punctate. The central spot marks the usual location of a coronal fossa, and contains one puncture. The frons is triangular with a few irregularly disposed punctures, and is sharply marked off

by a row of deep parietal punctures, which correspond to the frontal sutures (which are clearly defined in the larva of *E. jenksi*). The clypeus is a closely punctate black band separating frons from labrum. Genae black, coarsely punctate. Labrum free, shiny, smooth, apically setose, quadrate, $2/3$ as long as broad. Eyes granulate. Antennae with scape stout, yellow, with fine setigerous punctures; first funicular segment moniliform, not half as broad as scape; second to fourth funicular slender, longer than broad; the following joints, being laterally produced, form the club.

This differentiation of the antenna into three parts, scape, funicle and club, is almost as distinct as in the *Rhynchophora*.

The thorax has a deep, clear-cut antecostal suture, separating a narrow collar-like acrotergite, with a single row of punctures, from a bluntly elevated posttergite, with the whole surface coarsely rugulose punctate, the striations arranged in longitudinal lines medianly, diagonal or curved lines laterally, and transverse lines basally. The two middle costae on the frontal elevation form a diamond which narrows to parallel costae separated by several rows of punctate striae. From the crest there also arises two irregular ridges with three tumidities, directed toward the anterior angles. Scutellum transversely impressed at base.

The elytra are very tumid, with about fifteen elevations all coarsely rugulose punctate; these and interspace punctures minutely setigerous and more or less broadly separated; the sutural margins are closely saw-edge dove-tailed.

The plate of the prosternal basisternite (plate II, fig. 2) is shield-shaped, with long posterior stem, with slightly concave basal margin, all edges raised, so that the entire surface is concave, deeply and coarsely sculptured with setigerous punctures. The entire sternum of thorax is deeply and coarsely, transversely rugulose punctate, punctures minutely setigerous. The abdominal punctures are also transverse, minutely setigerous. The last segment is medianly apically transversely impressed in the form of a crescent lunule.

Pygidium basally rugulose punctate with elongate setigerous punctures, apically with separate round setigerous punctures; surface minutely granulate; median carina faint, lateral margins raised; also two arcuate low ridges which approach the median carina at their basal third and then diverge from it, terminating beyond middle of disc, thus forming an irregular depressed area, which is deepest laterally near base.

FEMALE: Length 2.6-2.8 mm.; breadth 1.8 mm., or 44 to 55% longer than broad. Agrees with male, except in following details:

Facial spots with interocular bars reduced to two faint spots; median spot also reduced; some specimens with two small

spots at anterior angles of frons; otherwise face black; antennal scape reddish brown. Punctures of vertex sparse, but rather evenly dispersed; but in ocular emargination, frons, clypeus and genae coarse, and transversely rugulose; all minutely setigerous.

Last abdominal segment with large round shallow depression, with punctures transverse in this area, and round beyond it.

Pygidium with carinae more distinct, but punctures more shallow and sparser.

3. EXEMA PUNCTATIPES LACORDAIRE, 1848

Exema punctatipes Lacordaire, 1848, Mon. des Coléoptères. Mem. Soc. Roy. des Sciences de Liege, 5:853-854.

This species is recorded by Jacoby in Biol. Centr. Amer. Coleoptera 6(1):88 from Mexico, Colombia, and Brazil.

4. EXEMA COMPLICATA JACOBY, 1881

6(1):89-90.

Exema complicata Jacoby, 1881, Biol. Centr. Amer. Coleoptera,

This species is recorded by Jacoby from British Honduras and Guatemala.

5. EXEMA GIBBER (FABRICIUS, 1798)

Clythra gibber Fabricius, 1798. Ent. Syst. Suppl., p. 112.

Chlamys gibbera Olivier, 1808. Entomologie. Coléoptères, 6:876, pl. 1, fig. 4.

Exema nodulosa Blatchley, 1913. Can. Ent., 45:22.

A full description is given by Blatchley, who in 1920 sunk his species under *gibber*. He records it from Florida on scrub oak. Linell (1898, Proc. U. S. N. M., 20:480) also recorded it from Louisiana. It will be seen from the original description that the type locality is in one of the Carolinas. Although the Leng (1920) Catalogue attributes this species to Olivier, 1791, Encyc. Meth., 6:876, it is in error, and the correct Olivier citation is as above, where Olivier gives the Fabricius citation.

The original Fabrician description is as follows:

"C. gibber. C. nigra thorace gibbo, elytris tuberculatis. Habitat in Carolina. Dom. Bosc.

"Minuta. Antennae testaceae. Thorax elevatus, gibbosus, immaculatus. Elytra nigra tuberculis plurimis parvis elevatis. Pedes nigri."

No specimens in this species are at hand for the present study.

6. EXEMA JENKSI new species (plates 1; 11, fig. 5)

Described from holotype ♂ (No. 1), allotype ♀ (No. 3), 4 ♂, and 9 ♀ paratypes, bred January 9 and February 12, 1940 in Los Angeles, California, on *Artemisia californica*, by George Elwood Jenks; of which 1 ♂ and 4 ♀s were dissected and slides made, with chitinous parts mounted separately to show the peculiar sclerite structures. All in Los Angeles Museum. Also one pair taken February 15, 1939, on *Encelia californica*, one ♀ January 26, 1939, on *Gnaphalium decurrens*, one ♀ August 17, 1938, on *Franseria bipinnatifida*, all on the El Segundo sand dunes, collected by W. D. Pierce (paratypes 16-19). In addition the following paratypes: 1 ♀ labelled "Cal. Jan. —" (No. 21); 1 ♀ Hynes, Los Angeles County, California, April 29, 1921, L. L. Muchmore 5759 (No. 22); 1 ♀ Cold Creek Ranch, San Bernardino Mountains, California, July 2, 1922, beating live oak, L. L. Muchmore 2365 (No. 23); 1 ♀ same loc., July 29, 1922, L. L. Muchmore 2500 (No. 24), all in collection Los Angeles Museum; 1 ♀, Los Olivos, Santa Barbara County, California, August 18, 1939, George P. Mackenzie (No. 20) in his collection.

In Mr. Jenks' article in Nature Magazine, to appear in June the name will unfortunately appear as *Exema dispar jenksi* Pierce, but I had not seen the original description of *dispar*, when the name was released to Mr. Jenks.

MALE: Length 2.32 mm.; breadth 1.46 mm., or 59% longer than broad. Black with considerable yellow spotting.

Face with yellow on vertex (except punctures and median basal zone), in median stripe between antennal bases, broadening over frontal area; with genal and clypeal zone black. Labrum clear, shining reddish brown. Punctures of face sparse, especially on yellow areas, and absent on suprascrobal above antennal condyles, which area is outlined by a semicircle of dots.

Prothorax with antecostal suture of separate punctures; frontal slope speckled with yellow. Median carinae irregularly parallel, and separated by several irregular rows of shallow setigerous punctures, the tiny setae appearing like shining gold. From the crests of these carinae branch a pair of diagonal carinae, and between these median and lateral carinae is a pair of short carinae.

The elytra are much speckled with yellow; tubercles round and sparsely punctured, not strigose, even at anterior margin. The intermediate punctures are shallow, setigerous (gold), without sharp margins, interspaces irregular and rounded.

Punctuation of undersides shallow, irregular and not as conspicuous as in *E. pennsylvanica*. Basisternite (plate 11, fig. 5) transversely impressed, coarsely punctate. Last sternal segment coarsely punctate, medianly flattened, faintly depressed. Preceding segments medianly depressed.

Pygidium deeply, sparsely punctate with a faint median ridge; the surface minutely granulate. Paratype No. 13 has yellow spots on each side of pygidium.

FEMALE: Length 2.29 mm.; breadth 1.5 mm., or 52% longer than broad.

Face with yellow more restricted, consisting of two stripes on vertex against eyes, separated by black, a small median spot connecting their lower angles, a spot in each eye emargination; the scape of the antennae, and the labrum.

Last sternal sclerite with round smooth median depression.

Pygidium more sparsely punctate, with median carina and two indistinctly raised discal carinae, apically diverging. Paratypes 4, 17, 18, 19 with yellow spots on each side.

INTERNAL ANATOMY: For the first time in this genus it is possible to describe the following characters, as a result of dissections.

ANTENNAE: The antennal scape is yellowish, much thicker than the funicular joints following, and as long as the four following joints, which may be considered as composing the funicle; these are reddish in color, and of these the first is about one-half as thick as the scape, but much thicker than the three following moniliform joints; the following six joints are laterally enlarged the first triangular in outline, 2-5 transverse, subquadrate in outline, 6th ogival pyramidal, and twice as long as 5th. These joints correspond to a club, and all but the first are black or very dark brown in color.

MOUTHPARTS: The mandibles are small, black, concave within, with an outer and inner tooth, and two rounded condyles; with a slender dorsal abductor muscle, and a large flat, fan-shaped dorsal adductor muscle.

The maxillae are attached to the subgenal margin of the head at each side of the mentum and consist of a transverse cardo, subquadrate stipes, lanceolate fringed lacinia, 2-jointed galea with last joint pubescent, and 4-jointed black palpus, moderately pubescent.

The labium consists of a mentum, prementum, with ligula, and 3 jointed palpus. The mentum is a free, black, quadrate plate, very deeply rounded emarginate to beyond its middle, thus appearing two-pronged; it has 3 punctures on each side in a longitudinal arrangement. The prementum is attached in the emargination of mentum, and is free; it is elongate, with the palpi attached at each side of the apex; palpi with the basal joint

small, but indicated by its dark marking, the second joint longer, with the third attached diagonally on the anterior margin, giving the palpus an elbowed form; last joint cylindrical, slightly tapering, truncate at tip. The ligula is pubescent, slightly separating the bases of the palpi.

A tongue-like hypopharyngeal plate (plate I, fig. 7) with two long posterior apodemes from the posterior corners, lies below the pharynx with a slight concavity on its inner surface. The apex is emarginate, heart-shaped, the base truncate, shape in general quadrate; with a few discal and marginal setigerous pores.

WINGS: The wing (plate I, fig. 8) consists, in the language of Snodgrass, of an axillary region, a remigium, vannus and jugum. The axillary region, consisting of three axillary sclerites; with costa, subcosta, radius and medius arising from the first two, cubitus and the anal veins from the third. The remigium contains all of the major veins, including cubitus. The indentation at which $M_4 + Cu$ reaches the margin is the boundary of vannus, which contains 3 anal veins. The second indentation bounds the jugum, which contains a rudimentary vein. The costal vein extends about one-third the length of the wing, terminating opposite the base of the darkened stigmal area. In its basal half, before and reaching a point opposite the arculus is a dark patch of extremely fine hairs. Subcosta is close to radius at base, but later joins costa, surpassing it and becoming the marginal vein to the end of the stigmal area. Radius is a strong vein thickened into a stigma, beyond which R_1 follows subcosta to the apex of the stigmal area; Radial sector bends downward toward Medius sending a cross vein to join Medius, and R_{2-5} is broken almost at its beginning, but is represented in the folded area by fragmentary darkenings. Medius arises at the side of Radius but crosses to Cubitus by the Arculus, and then faintly diagonally moves over and lies beside Radius in its dark stigmal area, very faintly crooks within the crook of radial sector and cross vein to join the cross vein which extends from radial sector to Cubitus; faint branches are visible in the folded area, indistinctly outlining a cell. Cubitus is a strong vein from base to the junction of Medius, at which point the united veins turn and go to the marginal notch marking the bounds of vannus. The first anal or vannal vein is but a rudiment, the second and third are complete.

MALE GENITALIA: The 9th segment under which the anus issues is a very fragile ring segment with only its outer margin chitinized, and is medianly dorsally shallowly emarginate, separating the chitinous margin. The 10th or ring segment is a very slender rod-like ring. The 11th or oedeagus is elongate oblong, apically squarely truncate with only soft anterior extensions. The flagellum of the ductus ejaculatorius is a very long chitinous

tube, appearing flexible, arising from a single tubular seminal vesicle, and passing through the chitinous endophallus into the oedeagus.

FEMALE GENITALIA: The 8th segment is dorsally two very narrowly chitinized plates (plate I, fig. 11). The 9th segment consists of 2 dorsal, 2 pleural and 2 ventral plates as illustrated. The 10th segment has a narrow chitinous band of 2 narrow dorsal plates. There is beyond this a faintly chitinized, lightly pubescent, tri-emarginate terminal or 11th segment. Internally were found two types of unpaired chitinous spermathecae attached to the ovipositor, one stout and bent, the other slender and coiled or serpentine. They differed as illustrated in two specimens (plate I, figs. 9-10).

THE LIFE HISTORY OF EXEMA JENKSI

The following notes on the life history were prepared from data furnished by Mr. George Elwood Jenks, who has prepared a beautiful series of photographs of the life history for Nature Magazine.

The adult beetles are active almost all year round in Los Angeles County, on *Artemisia californica*. Some specimens taken in April or May, 1939, were still alive January 9, 1940.

The egg is deposited, then fastened to a slender stem of frass. She covers the egg completely with abdominal excreta until it forms a stemmed cup flaring wider at mouth, and then covers this with a cap. The act of oviposition and covering is completed in 15 to 20 minutes. The egg stage lasts about 12 days at approximately 65° F. mean temperature.

The larva upon hatching cuts open the cap, and after some effort succeeds in catching hold of the branch. It pulls its case loose from the stem and immediately turns it upside down to cover itself (plate I, fig. 1). Under this case it feeds, walking about with its six legs all brought forward, as we shall see, by the freeing of the coxae. As it grows, it adds to the case from its excreta, forming a nipples cap-like case (plate I, fig. 2), the nipple being the original case. Within the case, the larva's position is unusual, as the abdomen is thrust up into the case, but bent downward at the middle, so that the anus is close to the legs (plate I, fig. 3). This enables it to manipulate the excreta in making its case.

The larval feeding period, in Mr. Jenks' experiments, took about seven weeks. When mature the larva seals the stem end of its case, and pupates. The prepupal, pupal and teneral adult periods occupy 28 to 30 days.

When mature, the adult cuts off a cap from the outer end of the case and emerges, looking almost exactly like the case from which it emerges. The adult resembles a dropping of a Lepidopterous larva, and is so constructed that it can fold all legs, and head appendages into grooves, and drop to the ground in a ball. On the ground it would be impossible to find it.

DESCRIPTIONS OF IMMATURE STAGES OF EXEMA JENKSI

EGG: Pure white, oval, in the proportion of 13 to 20. Length about 1.2 mm.

LARVA: The larva, even in the youngest stage, carries its body above it in a bent position; probably so that it can use its excreta in adding to the tube. The abdomen is bent forward beneath the body at the fifth segment, the anus reaching the base of the legs.

The first larva has the appearance of a little hermit crab, with its legs all extending beyond the head, and the head almost as long as the balance of the folded body. The head capsule measures 0.25 mm. from base to tip of mandibles, or 0.20 to genal margin; and 0.25 mm. in breadth. The two lobes of the occiput are clearly separated by the coronal suture, and separately rounded to this suture at base. The frontal sutures are distinct, clearly defining the front. (This corroborates the assumption that the yellow triangle on the face of the adult is the front.) The antennae are short, two-jointed, and separate two patches of ocelli, four in the upper patch and two in the lower. (In the adult these patches are united to form the compound eyes, with an emargination, in front of which are set the antennae). Each occipital has a semicircle of six punctures beginning with the ocelli, and curving inward, outlining very much the area occupied by the eyes in the adult. On the front there are four pairs of punctures making a sort of semicircle on each half. The labrum is broad and subquadrate. The labrum, mandibles, maxillae and labium viewed centrally appear as a rosette of petals, the legs are very interesting, being clustered closely to the head and all reaching forward, for the insect literally walks with its body erect in the air. Each leg (plate I, fig. 5) has a strong trochantin at the sides, to which is attached a long, movable coxa, which is longer than the femur, and has at its free end an elbow joint or first trochanter, to which is attached the second trochanter, a segment of triangular side view; the second trochanter and femur together almost equal the coxa; the tibia is a little shorter; the tarsus is reduced to a pretarsus in the form of a sickle shaped, or appendiculate single claw. The spiracles are very minute.

The head capsule of an intermediate stage measures from base to tip 0.29 mm., from base to margin of gena 0.25 mm., and in breadth 0.25 mm.

The head capsule of a fully matured larva (plate I, fig. 4) measures from base to tip 0.64 mm., from base to margin of gena 0.58 mm., and in breadth 0.54 mm.

PUPA (plate I, fig. 6): Length 2.29 mm.; breadth 1.37 mm. White, normal in form and not forecasting the peculiarities of the adult except that the head is ventral to the prothorax. The elytra are latero-ventral, leaving the entire dorsum exposed. The spiracles are dorsal. Prothorax dorsally is biemarginate. The seventh dorsal segment has a pair of lateral apical tubercles.

7. EXEMA PENNSYLVANICA, new species.

Described from 2 ♂, 6 ♀ labelled Allegheny County, Pennsylvania, two bearing the collector's label, Klages. This species has probably gone under the name *E. conspersa* in collections, but, as we have seen, the latter is a California species.

MALE: Length 2.4-2.5 mm.; breadth 1.5 mm., or 60-66% longer than broad. Black, except for orange to reddish markings as follows: The markings of the face are squared and resemble a formalized capital Greek psi; the yellow areas are more or less free of punctures, but outlined by them; on each side of vertex next to eyes is an oblong spot separated from a median zone by a row of punctures; the median zone at back is black, and coarsely punctate; then there is a short punctate yellow area, and in front of this an oblong spot which merges into two branches outlining the frontal sutures; a tiny yellow spot within a rim of black punctures in the ocular emarginations; and the scape of the antennae. The suprascrobal area, front of frons and clypeus, genae, and a corner of occiput behind eyes are black. The labrum is shining brown. The thorax is marked with red to orange color on the front margin of the posttergite, and in a narrow vertical column, as wide as between the eyes, and sometimes in a spot on the lower anterior angles; the palpi, spots on the femora, subbasal and subapical rings on the tibia and the tarsi are also of the same color.

The vertex is irregularly punctate, with a cluster of punctures in the median zone, few at sides. Ocular emargination acute angulate with a triangle of marginal punctures. The central spot connecting vertex with front is smooth; front is evenly, sparsely punctate. The black suprascrobal area is smooth, not elevated as in *E. dispar canadensis*. The labrum is transverse, shining, apically setose, and of entirely different texture from the face.

Prothorax with collar-like acrotergite separated from posttergite by the antecostal suture which is represented by a line of deep punctures. Posttergite greatly bluntly elevated, with two median subparallel carinae separated by two rows of coarse punctures. From the crest of these carinae diverge anteriorly a pair of diagonal twice-broken carinae. Surface densely, and coarsely punctate. Scutellum with longitudinal median carina to middle, posterior portion sloping, surface minutely granulate.

Elytra with anterior tubercles ascended by strigose lines. Tubercles acute; interspaces consist of coarse, deep, crater-like, setigerous punctures, separated only by their edges. Entire surface also minutely granulate.

Prosternal basisternite (plate II, fig. 4) squarely truncate, with sides almost parallel, posteriorly narrowed to a slender stem, margins raised, disc deeply pitted with large contiguous punctures.

Sternum of thorax and abdomen, and exposed portions of legs deeply pitted with almost contiguous setigerous punctures, the whole surface minutely granulate.

Pygidium very deeply and coarsely punctate, and tricarinate; the median carina separated from the shorter outward curving discal carinae by a row of deep punctures with a slightly raised cross bar in the middle.

FEMALE: Length 2.3 mm., breadth 1.6 mm., or 43% longer than broad. Differs from male in the following particulars: The orange of the thorax is reduced and sometimes does not extend laterally on the margins of the antecostal suture; the median area of vertex, emargination of eyes, and clypeus is black; punctuation of face is much more regular. Pygidium with punctures smaller, sparser, and carinae less acute. Last ventral segment with a round depression containing smaller punctures than surrounding surface.

One paratype has scattered orange dots on elytra.

8. *EXEMA INYOENSIS*, new species.

Described from one ♂ from Pine Creek, Round Valley, Inyo County, California, July 26, 1921, L. L. Muchmore 2197, on "sage," probably *Artemisia tridentata*.

This species is related to *pennsylvanica* and *jenksi* in face markings and prothoracic sculpture.

MALE: Length 2.70 mm., breadth 1.66 mm., or 62% longer than broad. Shining black, with orange brown spots on frontal slope of prothorax and head; antennae, funicle and club, and tarsi reddish brown.

Face minutely granulate; densely, coarsely punctate with setigerous punctures. The color marks are very irregular due to

black punctures; irregular bars next to eyes, narrowly connected to bands entering ocular emarginations, and centrally to an impunctate spot, which is continued on a narrow punctate frontal triangle; scape of same color as spots. The black suprascrobal area is coarsely punctate. Labrum transverse, shining yellow brown, setigerous.

Prothorax with antecostal suture depressed, containing transverse punctures; acrotergite narrow, minutely granulate; with a row of coarse, shallow punctures. The entire surface of the posttergite is densely, coarsely and deeply punctate with setigerous punctures, and with the surface of pits, walls, and tubercles minutely rugose at right angles to directions of walls. There are four orange spots on the anterior margin and two at the beginnings of the median carinae. Between these carinae are two rows of deep punctures. From the crests of these carinae branch a pair of diagonal carinae, and there are minor rugosities and carinations.

The scutellum is bluntly carinate to middle, thence to each apical angle, with its surface minutely transversely rugose.

The elytra are exceedingly roughly sculptured with deep basal striations, and the walls of the punctures very irregular and jagged, but all punctures are setigerous.

Prothoracic basisternite broadest at base, which is almost straight, very slightly narrowed and sides parallel a short distance thence narrowing to the stem, transversely impressed behind apex, lateral edges not elevated, surface closely covered with coarse, shallow punctures, whose walls are minutely transversely rugulose.

Entire under surface closely, deeply punctate with setigerous punctures, with the surface of pits and walls finely rugulose. Legs punctate and minutely granulate; femora and tibiae entirely black. Last abdominal segment medianly broadly depressed, faintly punctate. Pygidium with median carina and two irregular discal carinae; punctures setigerous, broad and shallow, with surface minutely rugulose.

9. EXEMA DESERTI, new species.

Described from a single male specimen from Victorville, San Bernardino County, California, on the Mojave Desert, collected by George Pierce Mackenzie, May 20, 1939.

MALE: Length 2.66 mm.; breadth 1.62 mm., or 64% longer than broad. Yellow and black, with the yellow predominating dorsally, and the black ventrally. Face yellow, except eyes, condyle of scape, a very narrow clypeal band, and a few black punctures on vertex. Prothorax yellow, with a few black spots, and black punctures. Elytra mainly yellow, especially on the tubercles, with suture, and most punctures, and scattered black

spots. Front femora yellow; middle and posterior femore with yellow apex; tibiae yellow with black median band. Ventral surfaces black, except a long spot on metepimeron, and spots on the first and fifth visible ventral segments. Pygidium with yellow spot opposite the one on fifth ventral on each side.

Entire surface minutely granulose.

Face sparsely punctate, each puncture minutely setigerous. The frontal elevation of prothorax is shining yellow, sparsely punctate. The thorax is much smoother than in most of the forms studied, with the median carinae indistinct, and extending only a short distance, with a confused double series of punctures between. Elytral tubercles low, smooth, more finely punctate than the intervals between. Pygidium with median carina complete, secondary carinae barely manifest, except that the outer side is emphasized by the deep lateral depressions; punctures deep, moderately close; with surface very minutely granulose striate.

9b. *EXEMA DESERTI BOREGENSIS*, new subspecies.

Described from one female, collected at Borrego, Imperial County, California, December 1, 1939, by George Pierce MacKenzie.

FEMALE: Length 2.45 mm.; breadth 1.58 mm., or 55% longer than broad. This specimen differs but little from the Victorville specimen, other than this difference in body proportions, which seems to be the normal sexual difference, but I would prefer that the allotype of *deserti* when described should be from the type locality.

The pygidium has the three carinae well defined, and the anterior margin wavy carinate, punctures very deep at base, moderately close and deep throughout; orange spot on each side.

10. *EXEMA GLOBENSIS*, new species.

Described from 1 ♂, 1 ♀ specimens from wheatfields near Globe, Arizona, collected August 2, 1925, by D. K. Duncan.

Face entirely orange yellow, including suprascrobal area, and clypeus, except on its front edge; punctures irregular. Thorax yellow in front half, posteriorly black, with scattered reddish spots. Elytra more or less evenly blotched black and reddish orange. Front femora orange yellow, other femora and tibiae with black junctions and central band. Basisternite (plate II, fig. 1) with central depressed area reddish. Ventral sclerites spotted with orange red on sides; pygidium predominantly black, with orange red spots on apical half.

Thoracic median carina in front separated by several rows of black punctures, and behind by two parallel rows of punctures. All punctures minutely setigerous. Otherwise the thorax

is but moderately tuberculose, not evidently carinate. The elytra are but moderately roughened with rounded tubercles, the most prominent of which are anteriorly concave. The pygidium is medianly faintly carinate, and rather densely punctate.

FEMALE: Length 2.41 mm.; breadth 1.58 mm., or 52% longer than broad.

Differs from male only in having more yellow on thorax; and the pygidium is tricarinate, quadrisulcate, and yellow except at base, and in apical median area.

11. EXEMA CHIRICAHUANA, new species.

Described from 5 ♂, 3 ♀ collected July 3-5-10, 1908, in the Chiricahua Mountains, Arizona, by V. Owen; all in the Los Angeles County Museum.

MALE: Length 2.6 mm.; breadth 1.6 mm., or 62% longer than broad. Black, roughly tuberculate; with yellow to orange colored blotchings on head and prothorax, and a few spots on elytra; antennae and blotchings on legs, orange to reddish; a few blotches on abdomen. A lateral spot on each side of pygidium may be present or absent.

All of head concealed in thorax, except face. Vertex, including the projections into emarginations of eyes, and frons, scape and labrum orange yellow, but punctures darker to black; eyes, a ring around antennal fossa, a narrow clypeal strip, and parietals black. Eyes finely granulate; deeply emarginate, with antennal fossa opposite lower lobe and slightly intruding into emargination; emargination about as wide as deep. When at rest the mandibles, maxillae and palpi fit into a socket in the raised prothoracic basisternite. The scape of antennae fits into a diagonal groove immediately in front of and truncating the eyes; the funicle and club lie in a groove between head and prothorax, which extends across prosternum between the basisternite and the pleura. This concealed portion of the antenna is darker, more reddish than the scape.

Prothorax is widest at base, almost as wide as humeri, with sides strongly diagonal, apex rounded and not more than half the width of base; posterior margin bisinuate, medianly with posterior lobe. Surface deeply punctate, roughly gibbous, irregularly blotched with dark reddish or orange.

The microstructure of the surface of the prothorax in front shows ultra-minute radiating striae in each puncture and over the intervening walls. In this character *chiricahuana* is allied to *deserti*, *boregensis*, *parvisaxi* and *globensis*, all from desert regions of California and Arizona. For this reason they might all be treated as races of a single species, but such a decision should await larger series and dissections.

The anterior margin or acrotergite is a collar limited by the antecostal suture, which is represented by a line of deep punctures. Anteriorly the thorax is almost perpendicular, then tumidly convex, and posteriorly sloping; the tumid disc is medianly channeled with two rows of punctures, between two carinae which extend to the middle. Behind this two diagonal ridges converge on the middle. The tumid disc is limited by a more or less circular depression. The scutellum is anvil-shaped, fitting the median lobe of prothorax, and with base and apex concave.

The elytra interlock with the scutellum, and are basally sinuate; medianly saw-edged, dovetailing; apically squarely truncate, but emarginate at junction of elytra; laterally broadly S-sinuate. Humeri umbonate; each elytron with about 12 tubercles, including humeri arranged diagonally in four rows; one at base in middle of anterior curve; three near humeri; two in row with basal one; one at outer apical angle; one at middle of side; the other on the lateral slope. Elytral punctuation deep, irregular, with striae twisted; each puncture bearing a fine white scale-like seta; even the tubercles are punctate.

The undersides are greatly modified for the concealment of legs and head appendages, due to the sulling habits of the beetle.

The prothorax has a pleural ridge from humeral angle to the antennal fossa in front of the eyes. From this ridge, except near the antennae, where the coxae are attached, the surface is steeply declivous to form the fossa for the anterior legs. Between the coxa and the basisternite is a deep fossa for the antennal funicle and club (see plate II, fig. 3). The basisternite is raised, anteriorly broadest and cupped for the mouth parts, transversely impressed behind apex, coarsely punctate.

The mesothorax is very short, with coxae in contact, and lateral part punctate depressed in the fossa occupied by the two front pairs of legs. This fossa also is composed of an anterior smooth portion of metathorax, the median portion of which is deeply punctate with broad episternum, and the posterior portion deeply fossate for posterior legs. All sternal punctures are minutely setigerous.

The legs are blotched black and brownish, and fit perfectly into the grooves. The tarsi with first three joints broadly bilobed, with long white fringe. Claws appendiculate.

The abdomen is greatly distorted; the first segment anteriorly forming part of coxal cavity, laterally broad, surrounding the following segments, and almost cutting them from elytral contact; second and fourth very narrow bands, fifth broader, encircling the vertical pygidium, which is coarsely punctate throughout, with four longitudinal impressions, a median ridge

the entire length, and two lateral ridges, reaching beyond the middle, and a bar ridge connecting the three near base, beyond which they are more widely separated. All abdominal punctures minutely setigerous.

FEMALE: Length 2.8 mm.; breadth 1.8 mm., or 55% longer than broad. Very similar to male, but with the light colored area of face smaller, subtriangular, with a more or less disconnected branch into ocular emargination, which is triangular and about as deep as broad. Anterior portion of face, except labrum, black.

Pygidium apically broader, with few punctures in apical half, the three carinae distinct. Fifth abdominal segment medianly with large circular depression.

12. EXEMA PARVISAXI, new species.

The name is the Latin designation for the type locality. Described from 4 ♂ collected at Little Rock, Los Angeles County, California, by George Pierce Mackenzie, September 10, 1939.

FEMALE: Length 2.83-3.08 mm.; breadth 1.8-2.0 mm., or 51 to 54% longer than broad. Black, with face all dull yellowish, except eyes, and narrow clypeal band; prothorax with anterior vertical slope yellow clear around, beginning opposite antennal scape, but with collar-like acrotergite dark leathery brown; and two spots of black punctures in middle of yellow band opposite eyes; anterior and median femora dorsally yellowish; anterior tibiae basally and apically externally and entirely internally yellow; posterior legs black, or but slightly tinted externally.

Paratype 4 has the stature and sculpture of the other three but has the markings of typical *deserti*, indicating that this may only be a race.

Facial punctuation sparse, with a round bare spot on vertex. The punctures in the yellow anterior portion of prothorax are sparse and irregular, and appear to have a golden center; punctuation on the black areas is deep, and dense. The two median carinae are separated by about four rows of punctures, just above the smooth yellow area, and then narrow to two rows of punctures.

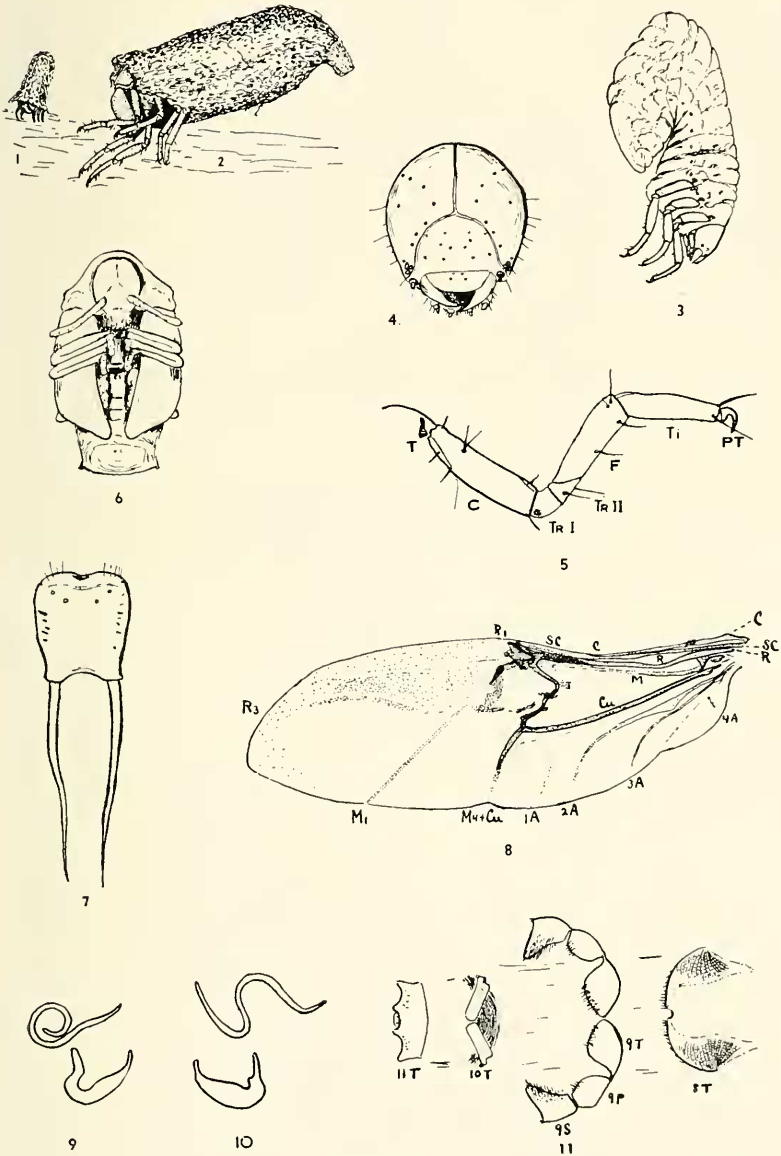


PLATE 1

ILLUSTRATIONS

PLATE I—*Exema jenksi*

- Fig. 1—First stage larva in inverted egg case.
Fig. 2—Mature larva in case, showing egg case as nipple.
Fig. 3—Mature larva removed from its case.
Fig. 4—Face of mature larva.
Fig. 5—Ventral side of right posterior leg. Lettering of Fig. 5—T, trochantin. C, coxa. TrI, TrII trochanter. F, femur. Ti, tibia. PT, pretarsus.
Fig. 6—Venter of pupa.
Fig. 7—Hypopharyngial plate of adult ♀ (paratype 9).
Fig. 8—Wing of ♂ (paratype 5). Lettering of Fig. 8—C, costa. SC, subcosta. R, radius. M, medius. Cu, cubitus. A, anal veins.
Fig. 9—Spermathecae of ♀ (paratype 10).
Fig. 10—Spermathecae of another ♀ (paratype 11).
Fig. 11—Tergites 8, 9, 10, 11, and pleurites and sternites 9 of ♀ (paratype 6).

PLATE II—Basisternites of five species.

- Fig. 1—*Exema globensis*.
Fig. 2—*Exema dispar canadensis*.
Fig. 3—*Exema chiricahuana*. C, clypeus. F, frons. G, gena. L, labrum. Md, mandible. Mx, maxilla. AF, antennal fossa. PN, pronotum. Cx, coxa. IBS, invaginated portion of basisternite.
Fig. 4—*Exema pennsylvanica*.
Fig. 5—*Exema jenksi*.

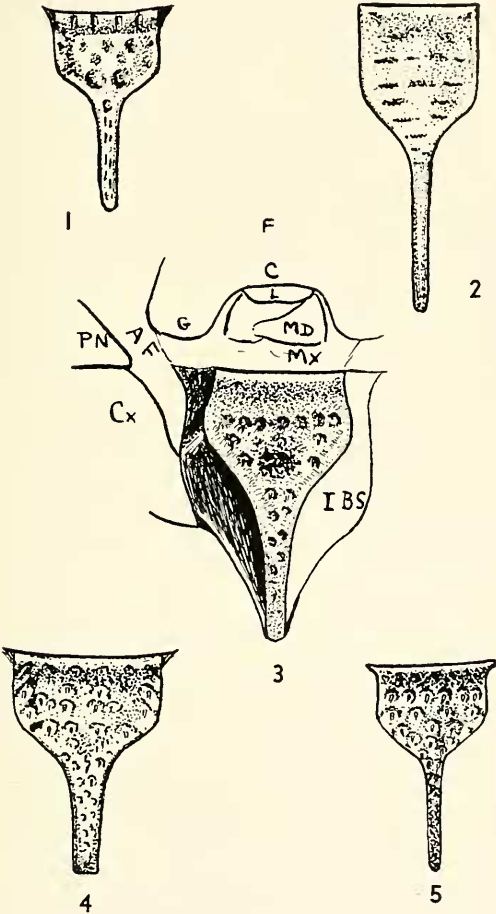


PLATE 2